

## **GOLD OR SILVER PARTICLES WITH PARAMAGNETISM, AND COMPOSITION CONTAINING THEREOF**

### **[Technical Field]**

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The present invention is related to gold or silver particles characterized by having paramagnetism, and to epilation agents, cosmetics, or toothpaste compositions containing the same.

### **[Background Art]**

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Studies on nano powder have been developed in Western Europe, U.S.A., Japan, etc. since they were begun in Russia in 1940s. Since the later part of 1980s, studies on nano powder have been conducted regularly in the fields of metals and ceramics. In the studies on nano powder, firstly, many processes of miniaturization of particles have been developed in order to utilize advantages of miniaturization of particle sizes such as purity, molding, mixing, fineness, etc., and it has been reported that nano-sized particles have shown many unusual properties.

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The effects shown according to nano-sizing of particles include heat transmission according to the increase in specific surface area; absorption; adsorption; surface effects such as catalytic characteristics; single crystallization of polycrystals; appearance of new phase and lowering of melting point according to the change in the mode of bonding of crystals; absorbance and scattering effects of light, sound wave, electromagnetic wave, etc.; volumetric effects such as the change in electronic state of

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materials; electricity and heat transmission, fluidity; mixability; and interaction effects among particles such as compressibility, solid-phase reactivity, etc. Owing to such effects, particle characteristics are greatly different from those of the conventional  $\mu$ -unit particles. It is, therefore, necessary to understand these characteristics and  
5 develop new application areas by putting them into practice.

The fields of application of nano particles vary according to whether nano particles are metals or ceramics. It has been published that nano powder has been applicable not only to highly functional and highly efficient materials designed in electronic, communication, and molecular units but also to drug transmission systems  
10 and selective new medicinal fields that have been proper for human bodies. In the bio-science field, it has been shown that it has been possible to develop synthetic skin in the hybrid system, analysis and manipulation of genes, and substitute materials for blood, and to make organs and skin having no side effects to human bodies. It has been also possible to reduce contaminated materials by removing unseen dust, minute particles  
15 and to use re-utilization materials. Besides, nano powder is applicable extensively to the fields of substitute energy and space aviation.

New characteristics of nano powder are shown by the increase in the specific surface area and change in electromagnetic properties in particles according to miniaturization of particles. In case of spherical particles, if it is assumed that the  
20 radius of an atom is  $d$  and the radius of a particle is  $r$ , the number of surface atoms is proportional to  $r^2/d^2$  and the number of inner atoms is proportional to  $r^3/d^3$ , and therefore, the ratio of the total number of atoms to the number of surface atoms is proportional to  $d/r$ . As the diameter of particles, i.e., size of particles, becomes smaller, the number of surface atoms is increased relatively, and accordingly, properties of nano

particles are governed by surface properties as the size of nano particles becomes smaller. If the particle diameter is 1  $\mu\text{m}$ , the specific surface area is about 1  $\text{m}^2/\text{cc}$ ; and if the particle diameter is 0.01  $\mu\text{m}$  (100  $\text{\AA}$ ), the specific surface area is about 100  $\text{m}^2/\text{cc}$ . If they are converted in terms of the ratio of the number of atoms on the surface and the  
5 total number of atoms, the ratios would be  $2 \times 10^{-4}$  in case of 1  $\mu\text{m}$  particles or  $2 \times 10^{-2}$  in case of 0.01  $\mu\text{m}$  particles assuming that the diameter of atoms is 2  $\text{\AA}$ . That is, the ratio of atoms on the surface is increased rapidly as the size of particles becomes close to the size of nano particles.

Accordingly, as mentioned in the above, since not only volumetric  
10 characteristics are decreased and surface characteristics are shown to be outstanding as the size of particles becomes smaller and the specific surface area becomes increased, but also new electromagnetic and optical properties are shown, demands for new industries applying nano particles are in an increasing trend.

In the meantime, the inventors of the present invention have conceived that the  
15 technology of automatic distribution or the equipment for automatic stabilization of nano metal powder, that have resolved all problems with the conventional methods of manufacture of nano powder but have not been found in other methods of manufacture, have been manipulated in one automatic line system, and invented equipment for the manufacture of nano powder equipped with the economic attribute that have not been  
20 comparable with other conventional methods of manufacture in the efficiency for energy and efficiency for production. These inventions have been published under PCT Laid-Open Patents No. 03/97521 and No. 03/70626.

Magnetic properties of materials are divided into strongly magnetic, weakly magnetic, and diamagnetic. Weakly magnetic materials are further divided into anti-

ferromagnetic materials and paramagnetic materials. In case of paramagnetic materials, magnetic effects of electrons including spinning and orbital movements are offset each other exactly in most of atoms or ions making atoms or ions show no magnetic properties. This is shown in inactive gases such as neon, etc., or copper ions forming copper, etc. However, in some atoms or ions, magnetic effects of electrons are not offset completely, and all atoms have magnetic dipole moment.

If  $n$  atoms having magnetic dipole moment are put into a magnetic field, these atomic dipoles tend to be arranged in parallel in the direction of the magnetic field. This tendency is called paramagnetism. If all of these atomic dipoles are arranged in one direction completely, the overall dipole moment will be  $n \mu$ . However, the process of arrangement is obstructed by heat movement. Already arranged state is broken as the collision occurs among atoms and kinetic energy is transmitted due to unmannerly vibration of atoms. How important heat movement is may be seen by comparing two types of energy: an average translational kinetic energy,  $(3/2) kT$ , of atoms at temperature  $T$  and energy difference,  $2 \mu B$ , in two states of parallel and non-parallel to the direction of magnetic dipole magnetic field. The former is considerably greater than the latter at/in an ordinary temperature or magnetic field. Therefore, heat movement of atoms assumes a role of blocking arrangement of dipoles. The magnetic moment does not reach the maximum  $n \mu$  at all although it is generated in the external magnetic field. In order to indicate the degree of magnetization of a material, magnetic moment per unit volume may be employed, which is called magnetization,  $M$ .

A material called a diamagnetic material has neither magnetic dipole of its own nor paramagnetism, but magnetic moment may be induced by the external magnetic field. Magnetic force is operated if samples of such material are placed near an

uneven and strong magnetic field. However, contrary to an electric material, samples are pushed away, not drawn to the sides of electrodes of a magnet. Such difference between electricity and magnetism is because electric dipole induced is in the same direction as that of the external electric field, whereas magnetic dipole induced is in the opposite direction to that of the external magnetic field. Diamagnetism is a property in which Faraday's law of induction is applied to electrons in atoms, where the movement of electrons is a very small current chain from a classical point of view. The fact that the direction of the induced magnetic moment is opposite to that of the magnetic field is the result of Lenz's law in view of the scale of atoms.

Diamagnetism is a property of all atoms. However, if atoms have their own magnetic dipole moments, diamagnetic effects are shielded by stronger paramagnetism or ferromagnetism.

In the meantime, gold and silver are typical diamagnetic materials. That is, gold or silver powder shows magnetic properties in the opposite direction to that of the external magnetic field, and such diamagnetic characteristics are not known to be changed even if the size of gold or silver powder becomes equivalent to the size of nano particles. The dispersibility of gold or silver powder is also inferior due to a high cohesive force among particles making the fields of its application limited. Therefore, in the fields of application coming from the original characteristics of gold and silver, gold nano powder is simply used for nano gold soaps, sports lotions, cosmetics, beverages, semi-conductor luminous elements, drug transmitters, etc.; and silver nano powder is applicable to bio products such as cosmetics, fibers, pigments, plastics, etc., and anti-bacterial, germicidal, and anti-contaminant materials.

The inventors of the present invention have developed nano powder having

paramagnetism which is a characteristic not owned by the conventional gold or silver nano particles. The above paramagnetic gold or silver powder has strong germicidal effects, and unique effects for increasing activities of various active components, that are not shown in the conventional diamagnetic gold or silver powder, and is  
5 characterized by having no cohesion property but a superior dispersibility.

It was confirmed that the effects for epilation were superior owing to the activation of germanium dioxide if paramagnetic silver was used along with germanium dioxide; if silver nano particles were added to toothpastes rather than adding the conventional diamagnetic silver particles, strong germicidal effects were shown, unique  
10 effects of increasing the activities of various active components contained in toothpaste compositions were shown, remarkable whitening effects were shown, the surface of teeth was shiny as there were no surface oxidation layers of the above paramagnetic silver and light scattering effects were superior, and there were operational effects of beautifying the appearance of teeth; and there were effects of increasing the activities of  
15 various active components contained in cosmetic compositions, promoting moisturizing effects of the skin, improving troubles of the skin, preventing the skin from being sticky, making the skin soft, and purifying the skin. The present invention was completed based on these findings.

## 20 [Summary of the Invention]

It is, therefore, an object of the present invention to provide with paramagnetic gold or silver powder having mass magnetism in the same direction as that of the external magnetic field, i.e., in the positive direction at all temperature ranges with

respect to that the conventional gold or silver powder is diamagnetic, where the paramagnetic gold or silver powder according to the present invention shows an extremely small coercive force, has no surface oxidation layers, is unstable at a room temperature, and has no cohesion property, but a high dispersibility.

5           It is another object of the present invention to provide with an efficient method of manufacture of paramagnetic gold or silver powder according to the present invention.

          It is still another object of the present invention to provide with epilation compositions containing paramagnetic silver and toothpaste compositions containing  
10   paramagnetic silver nano powder.

          It is yet another object of the present invention to provide with cosmetic compositions containing paramagnetic gold, or silver, or their mixture.

          Additional features and advantages of the present invention will be set forth in the description which follows, and in part will be apparent from the description, or may  
15   be learned by practice of the present invention. The objectives and other advantages of the present invention will be realized and attained by the process particularly pointed out in the written description and claims hereof, as well as the appended drawings.

          The present invention is related to gold or silver powder characterized by having paramagnetism. In more detail, contrary to the conventional gold or silver  
20   powder known to be a diamagnetic material having magnetism in the opposite direction to that of the magnetic field in the external magnetic field, the gold or silver powder according to the present invention is characterized by being a paramagnetic gold or silver powder having magnetism in the same direction as that of the external magnetic field, i.e., in the positive direction, in all temperature ranges, which is further

characterized by having saturated magnetic moment with the external magnetic field,  $H$ , of 2,000 to 8,000 Oe.

Further, the paramagnetic gold or silver powder according to the present invention is characterized by that inclination  $dM/dH$  of the mass magnetism curve is positive at an absolute temperature of 20K with the external magnetic field,  $H$ , of greater than 1,000 Oe. Still further, the paramagnetic gold or silver powder according to the present invention shows an extremely small coercive force, has no surface oxidation layers, is stable at a room temperature, has no cohesive property, and is highly dispersible.

The paramagnetic gold or silver powder according to the present invention is illustrated in detail below:

The conventional gold or silver powder as a typical diamagnetic material having magnetism in the opposite direction to that of the magnetic field when the magnetic field is applied externally. It has been known that such diamagnetic characteristic has not been changed although the size of the gold or silver powder has become nano-sized, and the fields of its application have been limited due to inferior dispersibility coming from high cohesive properties among particles.

As shown in Figure 1, the conventional silver powder has an increased mass magnetization,  $M$ , as the external magnetic field in the low magnetic field is increased. It is seen that mass magnetization is the highest at 2,000 Oe if the temperature of samples is 20K, and is reduced as the magnetic field is increased in case of  $H > 2,000$  Oe ( $dM/dH < 0$ ). Near 4,000 Oe, mass magnetization has a value of "0," and a negative value if the external magnetic field is  $H > 4,000$  Oe. The dependency on the magnetic field of the conventional silver powder shows a similar mode even when the



temperatures of samples are 100K and 300K. Also, in cases of 100K and 300K, the phenomenon that, mass magnetization is increased as the magnetic field is increased in a low magnetic field, is considerably weakened; while the phenomenon that the value of mass magnetization is reduced along with the magnetic field in a high magnetic field region, is shown to be remarkable. That is, mass magnetization according to the change in the magnetic field is increased as the temperature is increased in a high magnetic field region of greater than  $H > 2,000$  Oe.

As shown in Figure 2, the conventional gold powder also shows a trend that mass magnetization is rapidly increased as the magnetic field is increased in a low magnetic field ( $H < 1,000$  Oe), whereas inclination of mass magnetization curve is characterized by having a negative value ( $dM/dH < 0$ ) in a high magnetic field region of greater than  $H > 1,000$  Oe. These results of measurement show that the conventional gold and silver powders are diamagnetic materials.

In contrast, the gold or silver powder according to the present invention has paramagnetic characteristics having mass magnetization in the same direction as that of the external magnetic field, i.e., a positive mass magnetization, in all temperature ranges.

The size of paramagnetic gold or silver powder according to the present invention is not limited specially, but usually, paramagnetic characteristics are shown when the size of powder is in the range of less than  $40\ \mu\text{m}$ , and are shown significantly as the size of powder becomes smaller as the inclination of mass magnetization is shown to be varied according to the size of powder. Hollow-structured gold or silver particles of which insides are not filled in also show paramagnetic characteristics, and gold or silver powder according to the present invention shows paramagnetic characteristics in all temperature ranges below a room temperature although mass

magnetization curves are shown to be varied according to the temperature of the powder. Also, the silver or gold powder according to the present invention shows a coercive force of less than 5 Gauss in the temperature range of a room temperature, particularly, an extremely small coercive force of less than 2 Gauss at a room temperature.

5           If the size of the silver powder according to the present invention is less than 20  $\mu\text{m}$ , the silver powder shows super-paramagnetic characteristics below the absolute temperature of 100K, the inclination of  $dM/dH$  of the mass magnetization curve of a positive value, and the inclination  $dM/dH$  of the mass magnetization curve of  $3 \times 10^{-7}$  emu/g·Oe at an absolute temperature of 20K.

10           Further, whereas the conventional silver powder has an extremely small amount of mass magnetization when the absolute temperature is 20K and the external magnetic field is lower than 4,000 Oe, or when the absolute temperature is 100K and the external magnetic field is lower than 2000 Oe, the silver powder according to the present invention shows paramagnetic characteristics from the region where the external  
15           magnetic field is low to the region where the external magnetic field is as high as 20,000 Oe. It shows a rapidly increasing mass magnetization up to a specific magnetic field, i.e., a saturated magnetic field, shows dependency on a weak magnetic field in the magnetic field region of greater than the saturated magnetic field, and has a saturated magnetic moment when the external magnetic field, H, is 2,000 to 8,000 Oe.

20           Whereas the conventional gold powder shows the inclination  $dM/dH$  of the mass magnetization of a positive value when H is lower than 2,000 Oe, the paramagnetic gold powder according to the present invention shows the inclination  $dM/dH$  of the mass magnetization curve of a positive value in all external magnetic field ranges at temperature ranges of lower than a room temperature. Compared to the

conventional gold powder, the paramagnetic gold powder according to the present invention shows a greater mass magnetization by about 10 to 100 times, particularly, the inclination  $dM/dH$  of the mass magnetization is greater than  $4 \times 10^{-6}$  at an absolute temperature of 20K when the external magnetic field, H, is 10,000 Oe if the size of the gold powder is less than 1  $\mu\text{m}$ .

Still further, whereas surface oxidation layers are observed in most cases of the conventional silver powder as seen in an SEM photograph of the conventional diamagnetic silver powder in Figure 3, the paramagnetic gold or silver powder according to the present invention has no surface oxidation layers, is stable at a room temperature, and has no cohesive property but a high dispersibility as seen in TEM photographs in Figures 4 to 8.

Hereinafter, a method of manufacture of the paramagnetic gold or silver powder according to the present invention is illustrated.

The paramagnetic gold or silver powder according to the present invention was manufactured by using the equipment disclosed in PCT Patent Laid-Open Publications No. 03/97521 and No. 03/70626 mentioned in the above, whereas a brief diagram of the equipment for the manufacture of the paramagnetic gold or silver powder according to the present invention is shown in Figure 9.

The method of manufacture of the paramagnetic gold or silver powder according to the present invention is comprised of the steps of:

- 1) generation of argon plasma having an absolute temperature of 4,000 to 200,000K by using an RF power amplifier of 13.56 MHz and 5 to 50 kW and an inductive coupled plasma torch in a vacuum reaction tube;

- 2) production of gold or silver metal plasma by reacting argon plasma

generated in the above and diamagnetic gold or silver powder; and

3) manufacture of paramagnetic gold or silver powder by cooling rapidly the gold or silver metal plasma gas thus produced below a room temperature under a vacuum in a nano powder collection equipment installed at the lower end of a plasma  
5 reaction furnace.

In the equipment for the manufacture of the high-purity paramagnetic gold or silver powder according to the present invention, RF power system (1) is connected to RF matching circuits of hybrid control-type matching system (2) through about 5 m RF transmission line, matching circuits are connected mechanically to the helical antenna  
10 of inductive coupled plasma torch (3) by means of 0.5 mm-thick, 20 mm-wide, and 400 mm-long to the maximum copper ribbon-type plates, and the above antenna is put to earth electrically by first class. The helical antenna should be cooled with low-conduction cooling water of the low-conduction-water cooling system (9). Viton O-ring seals are equipped with in order to maintain a vacuum of  $10^{-5}$  torr by integrating all  
15 of the inductive coupled plasma torch (3), plasma reaction tube system (4), raw material injection system (6), and powder collection system (8) with vacuum exhaustion system (7). Particularly, RF is connected between (3) and (4), and between (3) and (6), by using Teflon disks that are longer than 10 mm to prevent a short to the earth through the walls of (3), (4), (6), and (8) so that plasma is not shown directly, and also, (3), (4), (6),  
20 and (8) are installed with cooling taken into consideration in order to prevent gases contaminated by heat transmission from coming out. All of (3), (4), (6), and (8) should be installed vertically since a free-falling injection method without using transfer gases is used in order not to have the transfer of raw material powder affect the quality of plasma to the maximum.

Raw material injection system (6) is connected to the reaction gas control system (5), vacuum gauge, reaction gas buffer tank of the reaction gas control system (5), and reaction gas flow control system.

Reaction tube system of the plasma reaction tube system (4) assumes a role of  
5 confining metal plasma, and stainless steel or glass is used for the system according to what is the material. Also, manual RF inductive elements (antennas) are installed at the inner and outer parts of the plasma reaction tube system (4) in order to control the temperature of metal plasma, where the position of manual elements (antennas) or the gaps among elements are controlled according to the granularity and appearance of the  
10 synthesized powder. The final liquid nitrogen heat exchange system (10) is installed inside of the vacuum of the bottom part of this reaction tube in order to control the granularity of the synthesized powder. A cooling system is equipped with enabling control of the temperature of cooling by using water, low-temperature nitrogen, or liquid nitrogen according to the material and the granularity of the material. It is  
15 connected through vacuum bonding with shrinkage during cooling taken into consideration in order to use liquid nitrogen.

Next to the liquid nitrogen heat-exchange system (10), the powder collection equipment of the powder collection system (8) is attached, which is consisted of a powder collection chamber and a metal collection filter. In some cases, the metal  
20 collection filter is manipulated to be cooled with liquid nitrogen, and available for re-use. The metal filter is manufactured with a stainless material selectively or in layers up to 100 to 2,300 meshes according to the type of the powder to be manufactured. The lower end of the collection equipment is constructed to be connected to a vacuum exhaustion device at a right angle.

Generally, about 40,000 to 200,000K plasma, preferably, 40,000 to 60,000K plasma is generated by using an inductive coupled plasma torch. The RF power amplifier used here is of 13.56 MHz 10 kW (~50 kW) grade, and the degree of vacuum is adjusted to be about 1 torr when the temperature and density that are proper for the actual reaction are obtained by generating the plasma under the vacuum condition of  $10^{-3}$  torr and increasing the amount of input of argon which is the reaction gas. Both of the single-type and double-type RF power amplifiers may be used. If it is of the single type, it is preferable to have an output of greater than 7 kW; and if it is of the double type, it is preferable that each is greater than 5 kW. In view of the efficiency for synthesis and control of material characteristics, it is preferable to use double-type RF power amplifier which is positioned on top and at the bottom of the plasma reactor or multiple-type RF power amplifier. It depends on the time of reaction with plasma, i.e., the time taken to become a metal plasma completely, according to the size of raw material powder to be used. And it is necessary to have centered plasma or hollow plasma according to each section in the reaction tube. The construction of plasma may be controlled by controlling the manual RF application elements with Yugawa-type, trapezoidal, or helical antenna, etc.

The size and shape of particles are controlled through a rapid heat exchange in vacuum after making raw materials be in the atomic or metallic plasma gas state completely by reacting the plasma thus generated with about 1 to 50  $\mu\text{m}$  gold or silver raw material to be synthesized. In general cases, in order to maintain the size of particles to be smaller than 100 nm, the calorie of gold or silver should be exchanged within 500 msec, and the time for heat exchange should be shortened as the size of particles is smaller. It is necessary to control the time of heat exchange sequentially in

order to control the shape of particles in vacuum according to what is the material. Various types of powder may be synthesized by controlling the gap of the manual RF antenna in the vacuum reaction tube in the array form., Particularly, desired-sized powder may be obtained by controlling variables such as the length of reaction flame in which plasma is formed, the time and temperature of rapid cooling of the gold or silver plasma gas, etc.

Also, paramagnetic silver according to the present invention has a fast absorption power to the skin, a good feeling when it is touched to the skin as it is not sticky, effects for epilation and prevention of hair loss when it is used along with germanium dioxide, superior anti-bacterial, germicidal, and anti-contamination effects, superior effects for making teeth look beautiful, and characteristics of beautifying the appearance of teeth by having their surface sparkling owing to scattering of light as there are no oxidation layers on the surface of the powder. And paramagnetic gold or silver according to the present invention is characterized by increasing the activity of active components of cosmetics, having a superior skin absorption property, having superior anti-bacterial effects, being proper for various sensitive skins, and improving skin troubles.

#### [Brief Description of the Drawings]

The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and, together with the description, serve to explain the objects, advantages, and principles of the invention.

In the drawings:

Figure 1 is a graph showing how the conventional diamagnetic silver powder is dependent on the magnetic field;

Figure 2 is a graph showing how the conventional diamagnetic gold powder is dependent on the magnetic field;

5        Figure 3 is an SEM photograph of the conventional diamagnetic silver powder;

Figure 4 is a TEM photograph of the paramagnetic silver powder according to the present invention (Ag white type, 1 to 40  $\mu\text{m}$ );

Figure 5 is TEM photographs of the paramagnetic silver powder according to the present invention (Ag gray type, 50 nm to 3  $\mu\text{m}$ );

10       Figure 6 is TEM photographs of the paramagnetic silver powder according to the present invention (Ag black type, 1 to 50 nm);

Figure 7 is a TEM photograph of the paramagnetic silver powder according to the present invention (Ag hollow type, 1 to 500  $\mu\text{m}$ );

15       Figure 8 is TEM photographs of the paramagnetic gold powder according to the present invention (Au black type, 1 to 20 nm);

Figure 9 is a brief diagram of the equipment for the manufacture of the paramagnetic gold or silver powder according to the present invention;

Figure 10 is a graph showing how the paramagnetic silver powder manufactured in Preferred Embodiment 1 is dependent on the magnetic field;

20       Figure 11 is a graph showing how the paramagnetic silver powder manufactured in Preferred Embodiment 2 is dependent on the magnetic field;

Figure 12 is a graph showing how the paramagnetic silver powder manufactured in Preferred Embodiment 3 is dependent on the magnetic field;

Figure 13 is a graph showing how the paramagnetic silver powder



manufactured in Preferred Embodiment 4 is dependent on the magnetic field;

Figure 14 is a graph showing how the conventional diamagnetic silver powder is dependent on the temperature;

Figure 15 is a graph showing how the paramagnetic silver powder  
5 manufactured in Preferred Embodiment 1 is dependent on the temperature;

Figure 16 is a graph showing how the paramagnetic silver powder manufactured in Preferred Embodiment 2 is dependent on the temperature;

Figure 17 is a graph showing how the paramagnetic silver powder manufactured in Preferred Embodiment 3 is dependent on the temperature;

10 Figure 18 is a graph showing how the paramagnetic silver powder manufactured in Preferred Embodiment 4 is dependent on the temperature;

Figure 19 is a graph showing how the paramagnetic gold powder manufactured in Preferred Embodiment 5 is dependent on the magnetic field;

15 Figure 20 is a graph showing how the conventional diamagnetic gold powder is dependent on the temperature; and

Figure 21 is a graph showing how the paramagnetic gold powder manufactured in Preferred Embodiment 5 is dependent on the temperature.

#### [Description of the Preferred Embodiments of the Invention]

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The silver raw material powder used in the present invention has a purity of greater than 98%, is of spherical shape, has a size of 1 to 50  $\mu\text{m}$ , and is manufactured in the atomizing and liquid reduction method or mechanical milling method. In contrast, the gold raw material powder used in the present invention has a purity of greater than

98%, is of spherical or thin-plated shape, has a size of 20 to 100  $\mu\text{m}$ , and is manufactured in the atomizing and liquid reduction method or mechanical milling method.

5 [Manufacturing Example 1]

Argon plasma of 38,000 to 45,000K ( $T_{\text{max}} = 84,000\text{K}$ ) is generated under the vacuum condition of  $10^{-3}$  torr by using an inductive coupled plasma torch, an RF power amplifier of 13.56 MHz to 10 kW grade (7 kW or greater in case of single type, or 5 kW  
10 or greater per amplifier in case of double type for an RF power amplifier), and an RF power application element of the helical antenna. When the temperature exceeds 30,000K, which is a proper temperature for the actual reaction, and the density of argon plasma exceeds  $4 \times 10^{11} \text{ g/cm}^3$ , the degree of vacuum should be adjusted to be about 1 torr by increasing the amount of input of argon (99.999% pure), which is a reaction gas.  
15 The length of the reaction flame in which the plasma generated is formed is adjusted to be 600 to 700 mm and reacted with the silver raw material powder. After the raw material powder becomes in the atomic or metallic plasma gas state completely, spherical paramagnetic Ag white type powder having the size of 1 to 40  $\mu\text{m}$  is obtained by cooling in water through a rapid heat exchange at 20 to 30°C for 2 to 5 seconds  
20 under the vacuum condition. As shown in Figure 4 which is the TEM photograph of the white silver powder obtained, no oxidation layers exist on the surface of silver powder. Also, the surface has a very precise nano-sized structure.

[Manufacturing Example 2]

The length of the reaction flame in which plasma is formed is adjusted to be 300 to 400 mm. After the metallic plasma becomes in the gas state, spherical paramagnetic gray silver powder (Ag gray type) having a size of 50 nm to 3  $\mu\text{m}$  is  
5 obtained under the same conditions for manufacture as those of Manufacturing Example 1 except that cooling is done in liquid nitrogen at -50 to -100°C for 0.5 to 1 second under the vacuum condition. As shown in Figure 5, which is the TEM photograph of the gray silver powder obtained, no oxidation layers exist on the surface of silver powder.

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#### [Manufacturing Example 3]

The length of the reaction flame in which the plasma is formed is adjusted to be 250 to 300 mm by using two manual RF application elements of the trapezoidal antenna  
15 in the reaction tube. After the raw material powder becomes in the metallic plasma gas state, spherical paramagnetic black silver powder (Ag black type) having a size of 1 to 50 nm is obtained under the same conditions for manufacture as those of Manufacturing Example 1 except that cooling is done in liquid nitrogen below -100°C for 0.1 to 0.3 seconds under the vacuum condition. As shown in Figure 6, which is the  
20 TEM photograph of the black silver powder obtained, no oxidation layers exist on the surface of silver powder. And powder particles are not shown to be cohesive, but are dispersed well in distilled water, ethanol, methanol, etc.

#### [Manufacturing Example 4]

The length of the reaction flame in which the plasma is formed is adjusted to be 1,200 to 1,500 mm by using four manual RF application elements of the Yugawa-type antenna outside of the reaction tube. After the raw material powder becomes in the metallic plasma gas state, paramagnetic hollow silver powder (Ag hollow type) having a size of 1 to 500  $\mu\text{m}$  is obtained under the same conditions as those of Manufacturing Example 1 except that 1 to 50 nm powder manufactured primarily (obtained in Preferred Embodiment 3) is used for the raw material powder instead of the silver raw material powder and cooling is done in water at 20 to 30°C for 2 to 5 seconds. As shown in Figure 7, which is the TEM photograph of the spherical silver powder obtained, no oxidation layers exist on the surface of silver powder. And it is seen that the spherical surface is comprised of individual silver particles, and the inside of the sphere is of hollow type.

[Manufacturing Example 5]

Spherical paramagnetic black gold powder (Au black type) having a size of 1 to 20 nm is obtained by using spherical and thin-plated 20 to 100  $\mu\text{m}$  gold raw material powder having a purity of higher than 98% for the raw material, using argon gas having a purity of 99.999% for the reaction gas, at the plasma temperature of 40,000 to 60,000K ( $T_{\text{max}} = 84,000\text{K}$ ), using 8 kW or greater for the single-type RF applied power or 6 kW or greater each of up and down for the double-type RF applied power, adjusting the length of the reaction flame in which plasma is formed to be 20 to 30 mm, and cooling in liquid nitrogen below -100°C for 0.1 to 0.3 seconds for the variables for the

heat exchange process. As shown in Figure 8, which is the TEM photograph of the gold powder obtained, no oxidation layers exist on the surface of silver powder. And powder particles are not cohesive even at a room temperature, but are dispersed well in distilled water, ethanol, etc.

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[Preferred Embodiment 1]

In order to compare and analyze magnetic properties of the paramagnetic silver powder manufactured in Manufacturing Examples 1 through 4 and the conventional  
10 diamagnetic silver powder (raw material silver powder), mass magnetization is measured by using Magnetic Property Measurement System (MPMS-XL, Quantum Design) while changing the temperature and magnetic field.

Experiments for the dependency on magnetic field are performed at absolute temperatures of 20K, 100K, and 300K; whereas experiments for the dependency on  
15 temperature are performed under the condition that the external magnetic field,  $H = 10,000$  Oe.

In order to extract only the magnetic moment coming from the powder, data are obtained by deducting the magnetic moment of diamagnetic capsules of each powder from the measured value of each powder.

20 As seen in Figure 1, the mass magnetization,  $M$ , of the raw material silver powder is increased as the external magnetic field is increased in a low magnetic field, is the maximum at 2,000 Oe if the temperature of samples is the absolute temperature of 20K, and is decreased as the magnetic field is increased in case of  $H > 2,000$  Oe ( $dM/dH < 0$ ). Near 4,000 Oe, the mass magnetization has a value of "0," and has a

negative value if the external magnetic field,  $H > 4,000$  Oe. And the dependency on the magnetic field shows a similar behavior even when the temperatures of samples are 100K and 300K.

In cases of 100K and 300K, the phenomenon that the mass magnetization is increased as the magnetic field is increased in a low magnetic field is considerably weakened, but the phenomenon that the mass magnetization is reduced along with the magnetic field in a high magnetic field region is shown to be remarkable. That is, the rate of change of the mass magnetization according to the change in magnetic field is increased as the temperature is increased in a high magnetic field region of higher than  $H > 2,000$  Oe, and the value of mass magnetization measured while increasing the external magnetic field and that measured while reducing the external magnetic field are the same. Further, there are no hysteresis characteristics observed.

Raw material silver powder shows diamagnetic characteristics in which the mass magnetization is reduced as the external magnetic field is increased in all magnetic field regions excluding low magnetic field regions ( $H < 2,000$  Oe). In high magnetic field regions of  $H > 4,000$  Oe, whereas the mass magnetization has a negative value, all of Ag white type, Ag gray type, and Ag black type manufactured in Manufacturing Examples 1 through 3 show a rapidly increasing mass magnetization up to a specific magnetic field (saturated magnetic field), and thereafter, a weak dependency on the magnetic field in magnetic field regions higher than saturated magnetic fields as seen in Figures 9 through 11.

In other words, at an absolute temperature of 20K and in a high magnetic field region of higher than a saturated magnetic field, the inclination of the mass magnetization curve shows a negative value smaller than "0" ( $dM/dH < 0$ ) in case of a

silver raw material. On the other hand, in case of the Ag white type, the inclination of the mass magnetization shows almost no dependency on the magnetic field, but has a positive value greater than "0" ( $dM/dH > 0$ ) of Ag gray type and Ag black type compared to the value of mass magnetization.

5 Ag hollow type also shows a tendency that mass magnetization is increased rapidly as the magnetic field is increased in low magnetic fields, but is reduced a little as the magnetic field is increased in high magnetic fields higher than the saturated magnetic field of about  $H = 4,000$  Oe.

Further, Figures 10 through 13 and 19 show magnetic properties when the  
10 magnetic field is increased and when it is decreased. It is seen that an extremely small coercive force of lower than 5 Gauss is shown and there is almost no coercive force in a part of cases in that the coercive force is lower than 2 Gauss. This implies that the gold or silver powder according to the present invention returns to the original state without loss of magnetic force when the external magnetic field is applied to and the  
15 magnetic field is removed, which further implies that paramagnetic materials according to the present invention may be applied to semi-conductor elements.

Saturated magnetic field values of each powder in Manufacturing Examples 1 through 3 and the maximum size of mass magnetization are shown in Table 1. And inclination of the linear portion of the mass magnetization in the regions higher than the  
20 saturated magnetic field is shown in Table 2.

[Table 1]

	20K		300K	
	Saturated magnetic field (Oe)	Maximum mass magnetization (emu/g)	Saturated magnetic field (Oe)	Maximum mass magnetization (emu/g)
White	7,500	$3.46 \times 10^{-2}$	6,000	$3.22 \times 10^{-3}$
Gray	5,500	-	5,000	$1.47 \times 10^{-2}$
Black	6,000	-	6,000	$4.47 \times 10^{-3}$

[Table 2]

	20K (emu/g Oe)	300K (emu/g Oe)
Raw	$-7.28 \times 10^{-8}$	$-1.27 \times 10^{-7}$
White	$-6.02 \times 10^{-8}$	$-1.37 \times 10^{-7}$
Gray	$3.63 \times 10^{-7}$	$-2.37 \times 10^{-7}$
Black	$2.84 \times 10^{-7}$	$-1.43 \times 10^{-7}$

5 As seen in Figures 15 through 18, the results of experiments for the dependency on temperature show the same meaning as the results of dependency on magnetic field mentioned in the above. That is, the absolute value of mass magnetization is shown to be reduced as the temperature is increased when the external magnetic field of 1 Tesla is applied to, and only the mass magnetization of the raw material silver powder has a

10 negative value in all temperature ranges. Ag white type, Ag gray type, and Ag black type powders including Ag hollow type have positive mass magnetization values in all temperature ranges if the capsule effect, characterized by having mass magnetization of smaller than "0," is removed.



Magnetic properties of the paramagnetic gold powder according to the present invention manufactured in Manufacturing Example 5 and of the conventional diamagnetic gold powder (raw material gold powder) are compared and analyzed under the same conditions as those of Preferred Embodiment 1.

5 As shown in Figures 4 and 19, both of the gold raw material and the gold powder according to the present invention manufactured in Manufacturing Example 5 shows a tendency that mass magnetization is rapidly increased as the magnetic field is increased in low magnetic fields ( $H < 1,000$  Oe), but in high magnetic field regions of higher than  $H > 1,000$  Oe, whereas the inclination of the mass magnetization curve of  
10 the gold raw material has a negative value ( $dM/dH < 0$ ), that of Au black type has a positive value ( $dM/dH > 0$ ). Au black type of Preferred Embodiment 5 has an about 10 to 100 times greater mass magnetization value according to the magnitude of the magnetic field compared to that of the raw material gold powder. Table 3 shows inclinations of the linear portion of mass magnetization curves of the gold raw material  
15 and Au black type.

[Table 3]

	20K (emu/g Oe)	300K (emu/g Oe)
Raw	$-8.60 \times 10^{-8}$	$-1.34 \times 10^{-7}$
Black	$4.35 \times 10^{-6}$	$3.55 \times 10^{-7}$

20 As a result of measurement for the analysis of dependency on temperature in the magnetic field of  $H = 10,000$  Oe, as shown in Figures 19 and 20, it is seen that the conventional gold powder has positive mass magnetization values in all temperature

ranges if capsule effect, characterized by having mass magnetization values of smaller than "0," is removed. These results of experiments for the dependency on temperature have the same meaning as the results of dependency on magnetic field described in the above. That is, it is seen that mass magnetization is shown to be reduced as the temperature is increased when the external magnetic field of 1 Tesla is applied to, while Au black type has an about 100 times greater mass magnetization value in all temperature ranges when the external magnetic field of 1 Tesla is applied to compared to the conventional gold raw material powder.

[Preferred Embodiments 3 through 5]

Manufacture of epilation agent compositions

The magnetic silver nano powder manufactured according to the method described in Manufacturing Example 3 is used for the paramagnetic silver nano powder to be added. Germanium dioxide included in epilation agent compositions according to the present invention is a natural organic lignite extract. High-purity lignite powder obtained through high-temperature combustion in a 1,600 to 2,000°C combustion furnace and washing with water of lignite is dissolved to have a concentration of 3 to 200 ppm.

Epilation agent compositions are manufactured by dissolving each component at 21°C by using the components and mixing ratios shown in the following Table 4. The epilation agent compositions thus manufactured are colorless and transparent, and has a pH of 7.76.

[Table 4]

Component	Preferred Embodiment 3	Preferred Embodiment 4	Preferred Embodiment 5
Paramagnetic silver nano particles	0.1 ppm	0.3 ppm	0.5 ppm
Germanium dioxide	30 ppm	30 ppm	30 ppm
Sucrose	-	10 g	10 g
Ethanol	-	100 ml	100 ml
Purified water	1,000 ml	900 ml	900 ml

## [Comparative Example 1]

5

Compositions are manufactured with the paramagnetic silver nano powder and germanium dioxide omitted from the compositions in the above Preferred Embodiments 3 through 5.

10

## [Testing Example 1]

Epilation effect experiments

15

Effects for epilation are measured for 15 patients of various hair-losing diseases in their thirties to sixties. Effects of epilation are evaluated by applying the epilation agent compositions manufactured in Preferred Embodiments 3 through 5 and the compositions in Comparative Example 1 not containing silver nano particles and germanium dioxide to the scalp of each patient. Administration of these compositions to the scalp is performed three times a day for 4 months, and the state of hair growth is

evaluated after 4 months. The criteria for evaluation are as follows: 1. Highly effective – newly grown hair (strong hair); 2. Intermediately effective – newly grown hair (downy hair); 3. A little effective – reduced number of hair loss; and 4. Not effective. The results of tests are shown in Table 5.

5

[Table 5]

Evaluation criteria	Preferred Embodiment 3	Preferred Embodiment 4	Preferred Embodiment 5	Comparative Example 1
Strong hair	5	7	9	0
Downy hair	7	5	4	0
Reduced hair loss	2	2	1	2
No effects	2	1	1	13

Table 5 shows that epilation agent compositions in Preferred Embodiments 3 through 5 containing paramagnetic silver nano particles and germanium dioxide have superior epilation effects, but it is confirmed that the compositions in Comparative Example 1 not containing silver nano particles and germanium dioxide show none of significant epilation effects.

Particularly, the compositions in Preferred Embodiment 5 containing a large amount of paramagnetic silver nano particles as well as saccharides show the best epilation effects, and newly born downy hairs or strong hairs begin to grow from the first or second month, and the effect of regeneration of hairs are shown in 13 patients among 15 patients from the fourth month. It is, therefore, confirmed that the epilation agents according to the present invention activate hair follicles shrunk by the immunity

reinforcement actions of paramagnetic silver nano particles and germanium dioxide, and thus, regenerate hair follicles. It is expected that they bring about superior effects for the acceleration of epilation and prevention of hair loss for the patients of hair loss eventually.

5

[Preferred Embodiments 6 and 7]

Toothpaste compositions

Toothpaste compositions are manufactured according to the components and  
 10 mixing ratios shown in the following Table 6 by using the paramagnetic silver nano particles manufactured according to the method described in Manufacturing Example 3 for the paramagnetic silver nano particles to be added:

[Table 6]

15

Component (wt %)		Preferred Embodiment 6	Preferred Embodiment 7
Silver nano particles		0.015	0.02
Abrasive	Silicon dioxide	10	10
Moisturizing agents	Sorbitol	60	60
	PEG1500	2.0	2.0
Binder	Cellulose gum	0.70	0.70
Bubbling agent	Sodium lauryl sulfate	2.20	2.20
Fluoride	Sodium fluorophosphate	0.75	0.75
Fragrances	L-mentol	0.10	0.10
	Eucalyptol	0.05	0.05

Sweetening agent	Xylitol	0.12	0.12
Viscosity promotor	Hydroxylated silica	9	9
Hemostat	Aminocaproic acid	0.09	0.09
Tartar formation suppressant	Sodium pyrophosphate	0.5	0.5
Whitening agent	Titanium oxide	0.30	0.30
Flavor		0.1	0.1
Purified water		14.08	14.07

[Comparative Example 2]

Toothpaste compositions

- 5 Toothpaste compositions are manufactured in the same method as those of Preferred Embodiments 6 and 7 except that no silver nano particles are contained.

[Comparative Example 3]

Toothpaste compositions

10

Toothpaste compositions containing the conventional silver particles are manufactured according to the components and mixing ratios shown in the following Table 7.

15

[Table 7]

Component (wt %)	Comparative Example 3
Colloidal silicon dioxide	5

Sorbitol	60
Glycerin	10
Xylitol	0.5
Aminocaproic acid	0.2
Allantoin chlorohydroxy aluminum	0.1
salt	5
Silver particles	1
Purified water	18.2

[Experimental Example 2]

Anti-bacterial effects of toothpaste compositions according  
to the present invention

5

Minimum inhibitory concentration (MIC) is measured in order to study anti-bacterial actions of toothpaste compositions containing silver nano particles of the present invention for caries bacteria and bacteria causing periodontal diseases.

Anti-bacterial power is evaluated in the agar culture medium dilution method  
10 by using brain heart infusion agar (BHIA) containing CPC in each concentration.

MIC measurement is done after culturing at 38°C under the condition of 5% CO<sub>2</sub> for 7 days in case of the bacteria causing periodontal diseases, or after culturing at 38°C under the aerobic condition for 3 days in case of the bacteria causing caries.

Anti-bacterial power is evaluated in the agar culture medium dilution method  
15 by using BHIA containing the components in Preferred Embodiments 6 and 7 and Comparative Example 2 and 3 in each concentration. Tests are performed with concentrations diluted in 10 steps in total by diluting testing toothpaste compositions 50 times to 2 times.

The results of the MIC measurement are shown in the following Table 8:

(1) Tested bacteria

1) Bacteria causing periodontal diseases: Actionbacillus  
actinomycetemcomitans, Fusobacterium nucleatum

5 2) Bacteria causing caries: Streptococcus mutans, Actinomyces  
viscosus

(2) Culture medium used

Blood agar culture medium (blood agar base + blood in an amount of  
5% of the final concentration) BHI agar

10

[Table 8]

Tested bacteria	MIC	Preferred Embodiment 6 (Dilution multiple)	Preferred Embodiment 7 (Dilution multiple)	Comparative Example 2 (Dilution multiple)	Comparative Example 3 (Dilution multiple)
Actionbacillus actinomycetemcomitans	7	200	200	100	100
Fusobacterium nucleatum	2.5	800	400	100	200
Streptococcus mutans	0.5	800	800	200	400
Actinomyces viscosus	2.5	800	800	200	400

As shown in Table 8, it is shown that MIC for showing the anti-bacterial power  
15 of each test tube is 0.5 to 7  $\mu\text{g/ml}$ , and the compositions in Preferred Embodiments 6  
and 7 of the present invention show two times greater anti-bacterial power in  
experimental strains compared to the compositions not containing silver nano particles



in Comparative Example 2 and toothpaste compositions containing the conventional diamagnetic silver nano particles in Comparative Example 3. Also, the compositions in Preferred Embodiment 6 having a greater amount of silver nano particles show a better anti-bacterial power against *Fusobacterium nucleatum* compared to the compositions in Preferred Embodiment 7. It is, therefore, seen that toothpaste compositions according to the present invention have a superior anti-bacterial power as they contain paramagnetic silver nano particles.

[Testing Example 3]

Evaluation of whitening effects of toothpaste compositions according to the present invention

In order to look into the sense of beauty and touch and the effect of shining of the toothpaste compositions according to the present invention, the toothpaste compositions in Preferred Embodiment 6 and Comparative Examples 2 and 3 are offered to 40 male and female subjects who are older than 10 years old and the above effects are evaluated based on blind tests. The results of evaluation are shown in the following Table 9:

[Table 9]

Characteristics	Preferred Embodiment 6 (Number of people responded)	Comparative Example 2 (Number of people responded)	Comparative Example 3 (Number of people responded)

Best feeling of beauty	31	3	6
Best feeling of touch	28	5	7
Best shining of teeth	35	1	4

It is shown from the results of Table 9 that the toothpaste compositions in Preferred Embodiment 6 containing the paramagnetic silver nano particles according to the present invention have better feeling of beauty and touch, and shining of teeth  
5 compared to the compositions in Comparative Examples 2 and 3 containing no silver or containing the conventional diamagnetic silver particles. Particularly, as to shining of teeth, most people responded show the reaction that the compositions according to the present invention are better. It is, therefore, confirmed that the toothpaste compositions according to the present invention make the surface gloss of teeth  
10 improved as they use paramagnetic silver having no surface oxidation layers, and thus, light scattering effects are superior.

[Preferred Embodiment 8]

Essences containing wrinkle improving agents

15

Essences are manufactured according to the components and mixing ratios shown in the following Table 10 by using the paramagnetic silver nano particles manufactured according to the method described in Manufacturing Example 3 for the paramagnetic silver nano particles to be added and using the paramagnetic gold nano

particles manufactured under the conditions described in Manufacturing Example 5 for the paramagnetic gold nano particles:

[Table 10]

5

Component	Content (wt %)
Purified water	Rest
Sitosterol	1.70
Polyglyceryl 2-oleate	1.50
Ceramide	0.7
Ceteareth-4	1.2
Cholesterol	1.5
Dicetyl phosphate	0.4
Concentrated glycerin	5.0
Sunflower oil	15.0
Carboxyvinyl polymer	0.2
Xanthan gum	0.2
Antiseptic	Small amount
Fragrance	Small amount
Ag nano particles	30 ppm
Au nano particles	10 ppm

[Preferred Embodiment 9]

### Skin lotions

10

Skin lotions are manufactured according to the components and mixing ratios shown in the following Table 11 by using the paramagnetic silver nano particles manufactured according to the method described in Manufacturing Example 3 for the

paramagnetic silver nano particles to be added and using the paramagnetic gold nano particles manufactured under the conditions described in Manufacturing Example 5 for the paramagnetic gold nano particles:

5 [Table 11]

Component	Content (wt %)
Purified water	Rest
Trehalose	3.0
Concentrated glycerin	3.0
Ethanol	3.0
Butylene glycol	2.0
Polyoxyethylene hardened castor oil	0.3
Phenyltrimethicone	0.15
Carboxy vinyl polymer	0.08
Triethanol amine	0.05
Ethylenediamine sodium tetraacetate	0.02
Fragrance	Proper amount
Ag nano particles	30 ppm

[Preferred Embodiment 10]

#### Nutritional toners

10

Nutritional toners are manufactured according to the components and mixing ratios shown in the following Table 12 by using the paramagnetic silver nano particles manufactured according to the method described in Manufacturing Example 3 for the paramagnetic silver nano particles to be added.

[Table 12]

Component	Content (wt %)
Purified water	Rest
Liquid paraffin	5.0
Tri(capric, caproic acid) glycerin	5.0
Cetyl octanoate	5.0
Concentrated glycerin	3.0
Polyglyceryl-3-methylglucose distearate	2.0
Cyclomethicone	2.0
Dimethicone	1.0
Stearic acid	0.8
Cetostearyl alcohol	0.7
Lipophilic monostearic acid glycerin	0.6
Triethanol amine	0.2
Carboxy vinyl polymer	0.15
Ethylenediamine sodium tetraacetate	0.02
Fragrance	Proper amount
Ag nano particles	30 ppm

## 5 [Preferred Embodiment 11]

Creams

10 Creams are manufactured according to the components and mixing ratios shown in the following Table 13 by using the paramagnetic silver nano particles manufactured according to the method described in Manufacturing Example 3 for the paramagnetic silver nano particles to be added and using the paramagnetic gold nano

particles manufactured under the conditions described in Manufacturing Example 5 for the paramagnetic gold nano particles:

[Table 13]

5

Component	Content (wt %)
Purified water	Rest
Liquid paraffin	10.0
Concentrated glycerin	7.0
Tri(capric, caproic acid) glycerin	5.0
Cetyl octanoate	5.0
Cyclomethicone	5.0
Propylene glycol	5.0
Vaseline	3.0
Stearic acid	2.0
Cetostearyl alcohol	2.0
Lipophilic monostearic acid glycerin	2.0
Triethanol amine	0.2
Monostearic acid polyoxyethylsorbitan	1.5
Dimethicone	1.0
Sesquioleic acid sorbitan	0.8
Ethylenediamine sodium tetraacetate	0.02
Fragrance	Proper amount
Ag nano particles	25 ppm
Au nano particles	10 ppm

[Preferred Embodiment 12]

Packs

Packs are manufactured according to the components and mixing ratios shown in the following Table 14 by using the paramagnetic silver nano particles manufactured according to the method described in Manufacturing Example 3 for the paramagnetic silver nano particles to be added and using the paramagnetic gold nano particles manufactured under the conditions described in Manufacturing Example 5 for the paramagnetic gold nano particles:

[Table 14]

Component	Content (wt %)
Purified water	Rest
Poly(vinyl alcohol)	15.0
Ethanol	5.0
Concentrated glycerin	2.0
Propylene glycol	2.0
Octyldodeceth-16	0.4
Sodium carboxy methyl cellulose	0.3
Polyoxyethylene hardened castor oil	0.2
Ethylenediamine sodium tetraacetate	0.02
Fragrance	Proper amount
Ag nano particles	20 ppm
Au nano particles	10 ppm

[Preferred Embodiment 13]

Foundations and make-up bases

Foundations and make-up bases are manufactured according to the components and mixing ratios shown in the following Table 15 by using the paramagnetic silver nano particles manufactured according to the method described in Manufacturing Example 3 for the paramagnetic silver nano particles to be added and using the  
 5 paramagnetic gold nano particles manufactured under the conditions described in Manufacturing Example 5 for the paramagnetic gold nano particles:

[Table 15]

Component	Content (wt %)
Purified water	Rest
Liquid paraffin	10.0
Tri(capric, caproic acid) glycerin	10.0
Titanium dioxide	10.0
Concentrated glycerin	5.0
Propylene glycol	5.0
Kaolin	3.0
Stearic acid	2.0
Monostearic acid polyoxyethylene sorbitan	1.0
sorbitan sesquioleate	0.8
Ferric oxide	0.5
Ferrous oxide	0.5
Triethanol amine	0.2
Ultramarine	0.2
Bentonite	0.1
Sodium carboxy methyl cellulose	0.05
Fragrance	Proper amount
Ag nano particles	30 ppm



Au nano particles	10 ppm
-------------------	--------

[Preferred Embodiment 14]

Cleansing lotions

5           Cleansing lotions are manufactured according to the components and mixing ratios shown in the following Table 16 by using the paramagnetic silver nano particles manufactured according to the method described in Manufacturing Example 3 for the paramagnetic silver nano particles to be added and using the paramagnetic gold nano particles manufactured under the conditions described in Manufacturing Example 5 for  
10   the paramagnetic gold nano particles:

[Table 16]

Component	Content (wt %)
Polypropylene glycol	3.5
Polyquaternium	2.6
Cetareth and stearyl alcohol (Cremophr A6, BASF)	1.6
Silicon suspension 30% (Fluka Chemie AG, Switzerland, Product No. 85390 Silicon antifoam)	10.0
Au nano particles	20 ppm
Ag nano particles	25 ppm
Zinc oxide	0.05
Water	82.0

15           [Comparative Example 4]

### Essences

Essences are manufactured with the same components and mixing ratios as those of the above Preferred Embodiment 8 except that no paramagnetic silver nano particles are contained.

Next, the following tests are performed with the products manufactured in the above Preferred Embodiment 8 and Comparative Example 4.

10 [Testing Example 4]

Experiments for the effects for skin absorption, sense of touch, and pliability

The products manufactured in Preferred Embodiment 8 and Comparative Example 4 are offered to 30 subjects based on blind tests. The characteristics of skin absorption, sense of touch, and pliability of each composition are evaluated for each subject. Characteristic (1) is to evaluate whether the speed of absorption of a composition to the skin is fast, Characteristic (2) is whether a composition is not sticky but soft to the skin, and Characteristic (3) is whether a composition is pliable to the skin. Grading is shown in terms of 1 to 4 which mean very superior, superior, average, and inferior. The results of grading are shown in the following Table 17:

[Table 17]

Sample	Characteristic	Very superior	Superior	Average	Inferior
Preferred Embodiment 8	Absorption	24	5	1	0
	Touch	21	6	3	0
	Pliability	18	8	4	0
Comparative Example 4	Absorption	7	7	12	4
	Touch	5	9	10	6
	Pliability	7	9	8	6

As seen from the above Table 17, it is seen that essence compositions according to the present invention have more superior absorption property of active components to the skin as well as more superior sense of touch and pliability compared to the conventional essence compositions containing no paramagnetic silver nano particles.

[Testing Example 5]

Effects for increase in skin elasticity (Synergism of active components)

10

Formulations of Preferred Embodiment 8 are applied to the surroundings of left eyes of 20 patients twice a day in order to experiment the effects of increase in elasticity of the skin when nutritional essences containing skin elasticity improving active components in the formulations of Preferred Embodiment 8 and Comparative Example 4 are coated onto the skin. Formulations of Comparative Example 4 are applied to the surroundings of right eyes. The elasticity of skin surface is measured with Cutometer SEM 474 after each process. The measurement of skin elasticity with Cutometer SEM 474 is a method of measurement of the elasticity of skin through suction of epidermis

with a negative pressure and measuring of the degree of suction. The smaller the value of suction is, the better the elasticity is. The value of elasticity is shown in terms of the value reduced in % compared to the value of the control group. The average value of those of 20 subjects is shown in the following Table 18. The values of the control group are measured values before samples are processed.

[Table 18]

Sample	Skin elasticity effect (days passed)	
	30	45
Preferred Embodiment 8	21.4	32.5
Comparative Example 4	9.1	13.6

It is seen from the above Table 18 that essence compositions according to the present invention increase the effects of active components.

## [Testing Example 6]

Tests for antiseptic power

15

In order to evaluate the antiseptic power of the cosmetic compositions of the present invention, mixed bacteria solutions of *Escherichia coli* (ATCC 8739), *Staphylococcus aureus* (ATCC 6538), *Pseudomonas aeruginosa* (ATCC 99027), etc. are added to 20 g of a cosmetics in the above Preferred Embodiment 8 to make the initial concentration per sample of  $10^6$  cfu/g (colony forming unit / g). These are cultured in a 30 to 32°C incubator for 4 weeks, and 1 g of each essence is taken at intervals of 1, 7,

14, 21, and 28 days in order to measure the number of alive bacteria. As a result of measurement, no alive bacteria are observed during the entire term of measurement. It is, therefore, seen that toner compositions according to the present invention have a superior antiseptic power.

5

[Preferred Embodiments 15 and 16]

Cosmetic compositions

Cosmetic compositions are manufactured according to the components and  
 10 mixing ratios shown in the following Table 19 by using the paramagnetic gold nano particles manufactured under the conditions described in Manufacturing Example 5 for the paramagnetic gold nano particles.

[Table 19]

Component (wt %)		Preferred Embodiment 15	Preferred Embodiment 16
Paramagnetic gold nano particles		10 (ppm)	15 (ppm)
Diluent	Ethanol	20	20
Softner	Castor oil	8	8
Moisturizer	Dimethicone	10	10
Surfactant	Butylene glycol	5	5
Emulsifier	PEG-10 hydrogenated castor oil	5	5
Physioactive materials	Palmitin retinol	3	3
	Arbutin	3	3
Viscosity controller	Polyglyceryl	1	1

	methacrylate		
Neutralizer	Triethanol amine	0.5	0.5
Chelating agent	Sodium tetraacetate	0.5	0.5
Astringent	Zinc stearate	0.5	0.5
Antiseptic	Ethylparaben	0.5	0.5
De-contaminant	Sodium tetraacetate	0.5	0.5
Purified water		43	43

[Comparative Examples 5 and 6]

5           The composition of Comparative Example 5 is manufactured in the same method as those of Preferred Embodiments 15 and 16 except that no paramagnetic gold nano particles are used, and the composition of Comparative Example 6 is manufactured according to the components and mixing ratios shown in the following Table 20:

10

[Table 20]

Component (wt %)		Comparative Example 5	Comparative Example 6
Diluent	Ethanol	20	25
Softner	Castor oil	8	5
Moisturizer	Dimethicone	10	5
Surfactant	Butylene glycol	5	10
Emulsifier	PEG-10	5	5

	hydrogenated castor oil		
Physioactive materials	Palmitin retinol	3	3
	Arbutin	3	3
Viscosity controller	Polyglyceryl methacrylate	1	1
Neutralizer	Triethanol amine	0.5	0.5
Chelating agent	Sodium tetraacetate	0.5	0
Astringent	Zinc stearate	0.5	0
Antiseptic	Ethylparaben	0.5	0.5
De-contaminant	Sodium tetraacetate	0.5	0
Purified water		43	42

[Testing Example 7]

Experiments for moisturizing effects

5           The ability to retain moisture of the skin is evaluated by using a corneometer after coating fixed amounts of a cosmetic composition containing the paramagnetic gold nano particles of Preferred Embodiments 15 and 16 and a cosmetic composition not containing the paramagnetic gold nano particles of Comparative Examples 5 and 6 onto the skin.

10       A fixed amount of the composition is coated on the inner forearm of each of 20 subjects in a thermohydrostat room at 22°C and a relative humidity of 50%, and rubbed well. The content of moisture of the skin according to the lapse of time is measured, and the results of measurement are shown in the following Table 21:

15           [Table 21]

Time (min)	Preferred Embodiment 15 (A.U.)	Preferred Embodiment 16 (A.U.)	Comparative Example 5 (A.U.)	Comparative Example 6 (A.U.)
0	114	119	111	110
10	105	113	93	91
20	97	101	81	80
50	89	95	55	52
100	84	88	40	39

As seen in Table 21, the cosmetic compositions of Preferred Embodiments 15 and 16 containing paramagnetic gold nano particles have much more superior moisturizing effects than the cosmetic compositions of Comparative Examples 5 and 6 not containing gold nano particles.

[Testing Example 8]

Experiments for the effects for skin absorption and sense of touch

10

Cosmetic compositions manufactured in Preferred Embodiments 15 and 16 and Comparative Examples 5 and 6 are offered to 30 subjects based on blind tests. The characteristics of skin absorption and sense of touch of 4 compositions are evaluated for each subject. Characteristic (1) is to evaluate whether the speed of absorption of a composition to the skin is fast, and Characteristic (2) is whether a composition is not sticky but soft to the skin. Grading is shown in terms of 1 to 4 which mean very superior, superior, average, and inferior. The results of grading are shown in the following Table 22:



[Table 22]

Sample	Characteristic	Very superior	Superior	Average	Inferior
Preferred Embodiment 15	Absorption	15	11	4	0
	Sense of touch	14	10	6	0
Preferred Embodiment 16	Absorption	16	12	2	0
	Sense of touch	15	11	4	0
Comparative Example 5	Absorption	5	11	12	2
	Sense of touch	5	12	11	2
Comparative Example 6	Absorption	4	13	10	3
	Sense of touch	6	9	13	2

5           As seen in Table 22, all subjects show superior skin absorption and touching reactions to the cosmetic compositions of Preferred Embodiments 15 and 16 containing the paramagnetic gold nano particles according to the present invention. On the other hand, about half of the subjects shows average or inferior reactions to the compositions in Comparative Examples 5 and 6 not containing paramagnetic gold nano particles. It is, therefore, confirmed that the cosmetic compositions containing the paramagnetic gold nano particles according to the present invention have superior skin absorption and touching effects.

#### [Industrial Applicability]

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Whereas the conventional gold or silver powder is diamagnetic, the

paramagnetic gold or silver powder according to the present invention is high-purity gold or silver powder, which shows an extremely small coercive force, is stable at a room temperature although there are no surface oxidation layers, is not cohesive, but has a high dispersibility. It is, therefore, advantageous in that it may be used for various material areas.

While certain present manufacturing examples, preferred embodiments, and comparative examples of the present invention have been shown and described, it is to be distinctly understood that the present invention is not limited thereto but may be otherwise variously embodied and practiced within the scope of the following claims.